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The genus *Syrrhoe* (Crustacea, Amphipoda, Synopiidae) from the North Atlantic

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Abstract

Three species of the amphipod genus *Syrrhoe* are described from the North Atlantic. The differences between these species are primarily the patterns of serration of the posterior margins of pleonite 3 and urosomite 1 and 2: *Syrrhoe affinis* has a wide convex space on the posterior margin between the epimeron 3 and the dorsal serration. In *Syrrhoe crenulata* and *Syrrhoe anneheleneae* **sp. nov.** there is only a small notch on the posterior margin of pleonite 3. *Syrrhoe anneheleneae* **sp. nov.**, otherwise similar to *S. crenulata*, has an additional serration on the posterior margin of urosomite 1. The inter- and intraspecific distances analyzed from COI confirm the morphological species concept of North Atlantic *Syrrhoe*.

Key Words

Taxonomy
systematics
Arctic Ocean
barcode
Syrrhoe affinis
Syrrhoe anneheleneae sp. nov.
Syrrhoe crenulata

Introduction

From September 26th–30th 2016 Dr. Anne Helene Tandberg and Prof. Wim Vader organized an amphipod identification workshop at the Marine Biology Station of the University of Bergen in Espegrend. During the workshop, amphipods collected in the North Atlantic, from the collections of the the University Museum of Bergen, were sorted and identified to species level. In the genus *Syrrhoe* we found the typical North Atlantic species *Syrrhoe crenulata* Goës, 1866, and *Syrrhoe affinis* Chevreux, 1908, the latter had originally been described from the Moroccan coast. A third species, which is similar to *Syrrhoe crenulata*, was very abundant in the material and showed to be new to science and is described herein together with redescriptions of both the other species. Additional synopiid samples were taken during the IceAGE expedition (Icelandic marine Animals: Genetics and Evolution) via R/V Meteor in 2011. The "barcode region" of the cytochrome oxidase was sequenced. A key to the North Atlantic *Syrrhoe* is provided.

Material and methods

Morphology

For taxonomic study, we transferred the material in a graded series of ethanol-glycerol mixes into pure glycerol and then mounted the specimen or dissected parts on slides for the preparation of the drawings. Pencil drawings of the habitus were made with on a Leica M 205c dissecting microscope and details of the appendages and mouthparts on a Leica DMLB compound microscope. Both microscopes were equipped with a camera lucida. The line drawings were made following the technique described in Coleman (2003, 2009). Measurements were

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made along the dorsal outline of the animals, from the rostrum to the end of the telson.

In the material examined the determination of sexes were given, when clear characters were visible (oostegites, eggs, penis papillae, antenna 1 characters) otherwise the specimens were marked as "without sex determination".

The material is held in the collections of the Zoological Museum, University of Bergen (ZMBN), Norway, the Leibniz Institute for Evolution and Biodiversity Science, Museum für Naturkunde Berlin (ZMB) and the Center of Natural History (CeNak) Hamburg, Germany.

Molecular methods

Isolation of DNA from five individuals was performed in CeNak using QIAGEN extraction kit (QIAamp DNA-Mini Kit) according to the manufacturer's protocol.

A fragment of the COI gene (ca. 670 bp fragment) was amplified using universal primer LCO-1490/HCO-2198 (Folmer et al. 1994). The PCR reaction mixes were prepared to a final volume of 15 µl containing 7,5 µl AccuStart II PCR ToughMix (Quanta bio), 0,6 µl of each primer (10 pmol/µl), 0,3 µl GelTrack loading dye, 4,8 µl dH_2O and 1,2 µl template DNA. PCR settings for amplifying CO1 sequences consisted of initial denaturing of 3 min at 94 °C, 38 cycles of 30 s at 94 °C, 50 s at 47 °C, 60 s at 72 °C, and final extension 5 min at 72 °C. PCR products were purified using the Exonuclease-I/Shrimp Alkaline Phosphatase (ExoSAP-IT, Applied Biosystems™) method and were sequenced at Macrogen Inc. Sequences were edited using Geneious 9.1.8 resulting in five sequences of length of 618-657 bp excluding primers. Relevant voucher information, taxonomic classifications, and sequences are accessible through the public data set "DS-SYRATL" in BOLD (http://www.boldsystems.org) (Ratnasingham and Hebert 2007).

The sequences were aligned with MAFFT v7.308 algorithm with default settings (Katoh et al. 2002, Katoh and Standley 2013) in Geneious 9.1.8. Uncorrected p-distance and the Kimura 2-parameter (K2P) model (Kimura1980) were used to determine sequence divergence in MEGA V7.0.18 (Kumar et al. 2016).

Systematics

Syrrhoe Goës, 1866

Syrrhoe Goës, 1866: 527. – Stebbing 1906: 281-282. – J.L. Barnard 1969: 462. – J.L. Barnard 1972: 52. – Barnard and Karaman 1991: 717. Type-species: *Syrrhoe crenulata* Goës, 1866

Diagnosis. Head protuberant or not, lateral cephalic lobe rounded to acute; molar not enlarged, weakly triturative; mouthparts basic; antenna 1 article 1 bearing large distally curved tooth, peduncle slightly elongate (female); coxa 1 ordinary or enlarged; coxae 3–4 pelagont; gnathopods with transverse or subtransverse palms bearing enlarged serrate defining robust seta; dactylus of gnathopod 2 normal; pereopods 5–7 elongate, dactyli elongate, basis heavily serrate or not, basis of pereopod 7 typically rounded posteroventrally but in few species becoming truncate; pleonites 1–3 typically serrate dorsally and laterally, but often smooth or bearing single dorsal tooth, uropod 3 peduncle short (except *S. nodulosa*); telson elongate, deeply cleft.

Species composition. *S. affinis* Chevreux, 1908; *S. angulipes* Ledoyer, 1977; *S. anneheleneae* sp. nov.; *S. crenulata* Goës, 1866; *S. kareenae* Lörz & Coleman, 2013; *S. longifrons* Shoemaker, 1964; *S. nodulosa* K.H. Barnard, 1932; *S. oluta* J.L. Barnard, 1972; *S. papyracea* Stebbing, 1888; *S. petitaserrata* Hughes, 2009; *S. psychrophila* Monod, 1926; *S. sadiae* Lörz & Coleman, 2013; *S. semiserrata* Stebbing, 1888; *S. serrima* J.L. Barnard, 1972; *S. tuberculata* Dahl, 1954

Key to the North Atlantic species of *Syrrhoe*

1 Unserrate space between epimeron 3 and dorsal serration of pleonite 3 wide and convex ..... *Syrrhoe affinis*
– Unserrate space between epimeron 3 and dorsal serration of pleonite 3 narrow and excavate 2
2(1) Posterior margin of urosomite 1 smooth ..... *Syrrhoe crenulata*
– Posterior margin of urosomite 1 serrate ..... *Syrrhoe anneheleneae* sp. nov.

Syrrhoe affinis Chevreux, 1908

Figs 1–5

Syrrhoe affinis Chevreux, 1908: p. 7, fig. 4. – Sexton 1911: 202, pl. 3, figs 1–8. – Chevreux 1919: 574. – Chevreux 1927: 86, pl. 7, fig. 27. – Chevreux 1935: 98, pl. 13, fig. 7. – J.L. Barnard 1972: 53. – Ledoyer 1977: 411, fig. 30. – G. Karaman 1986: 136, figs 8–10; fig. 11, 1–2. – Ruffo 1993: 715, fig. 492 *Syrrhoe* (?) *affinis* J.L. Barnard 1961: 80, fig. 49. Lörz and Coleman 2013, figs 44–49, 103–112

Material examined. 1 male (illustrated and described), 10 mm, 1 female, UM/BIO stations, HB-2016-01-21-2, Hjeltefjorden v. Stureterminalen, 60°37'48"N, 4°52'5"E, 230 m, 21.1.2016, RP sledge, ZMBN 127919; 1 female, 5 mm; UM/BIO stations, HB-2016-01-21-3, Hjeltefjorden v. Stureterminalen, 60°37'48.4"N, 4°52'5."E, 230 m, 21.1.2016, RP sledge, ZMBN 112491; 2 males, 9 mm and 8.7 mm, 1 female, MAREANO 2013, R961-710, 64°10'11"N, 8°5'50"E, 345 m, 05.10.2013, large VW grab, ZMBN 127921; 1 male, MAREANO 2013, R911-695 GR, 63°34'22"N, 7°25'24"E, 302 m, 4.10.2013, large VW grab, ZMBN 127923; 42 females, 30 males, 120 without sex determination, MAREANO 2012, R997-31, 62°30'30"N, 5°35'17"E, 277–282 m, 2.10.2012, RP sledge, ZMBN 127927; 19 females, 5 males, 42 without sex determination, MAREANO 2013, R911-101,

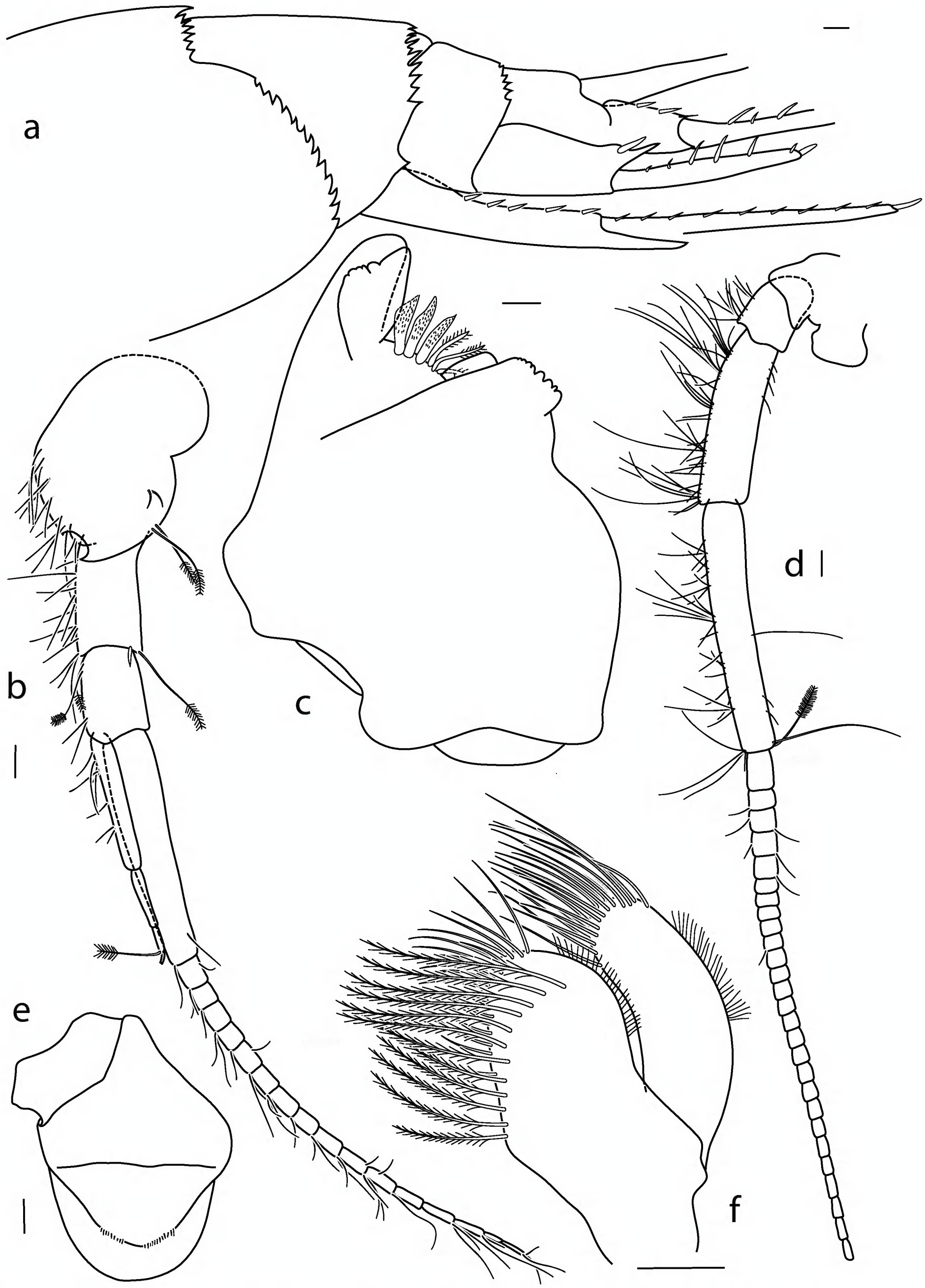

Figure 1. *Syrrhoe affinis*, male, 10 mm, ZMBN 127919. **a**) pleonite 3 and urosome; **b**) antenna 1; **c**) mandible; **d**) antenna 2; **e**) upper lip; **f**) maxilla 2. Scale bars: 100 µm.

63°34'42"N, 7°25'11"E, 305–308 m, 4.10.2013, RP sledge, ZMBN 127924; 11 males, 12 females, 43 without sex determination, MAREANO 2012, R1046-35, 62°22'9"N, 4°27'47"E, 193 m, 3.10.2012, RP sledge, ZMBN 127926; 5 males, 9 females, 105 without sex determination. MAREANO 2012, R1013-23, 63°18'49"N, 6°39'14"E, 225–226 m, 26.9.2012, RP sledge, ZMBN 127929; 1 female, MAREANO 2013, R1238-97, 62°44'54"N, 3°1'59"E, 567–569 m, 24.9.2013, RP sledge, ZMBN 127925.

Description based on: male, 10 mm, ZMBN 127919.

Head. *Head* slightly produced. Eyes invisible, no trace of ommatidea, unpigmented or not present; rostrum short, reaching half the length of article 1 of antenna 1; lateral cephalic lobe present, truncate. *Antenna 1* (Fig. 1b) article 1 with a distally curved tooth; article 2 without distomedial tooth, subequal to article 1; article 3 subequal to article 1, shorter than article 2; accessory flagellum 3-articulate, almost reaching end of first flagellar article, 2nd article of accessory flagellum shorter than half the length of 1st accessory flagellar article, minute 3rd article with terminal plumose seta and (broken off) stout seta; flagellum shorter than pereon, 17 articles. The accessory flagellum in female specimens is longer than the 1st flagellum article, it consists of a large basal article and a minute second article. *Antenna 2* (Fig. 1d) slightly surpassing pereon segment 7; flagellum broken off, but at least 27 articles. *Labrum* (upper lip) (Fig. 1e) entire, rounded. *Mandible* (Fig. 1c), incisor multidentate (worn down, number unknown); left lacinia mobilis wide, 5?-dentate (wide, 6-dentate on right side); accessory setal row on the left side distally with 3 blade like stout setae and 3 plumose setae proximally (with 2 blade like setae and 3 plumose setae on the right mandible); molar small, columnar, weakly triturative, with strongly serrate margin; mandibular palp 3-articulate, terminal article minute, with 5 very long stout setae. *Maxilla 1* (Fig. 2a) inner plate with 7 long and distally 2 shorter plumose setae; outer plate with 11 apical robust setae lined with denticles; palp article 2 outer margin smooth, with apical and medial setation. *Maxilla 2* (Fig. 1f) outer plate slightly longer than inner plate; inner plate width more than 2 × outer plate. *Maxilliped* (Fig. 2 b–e) inner plate truncate distally with some mediodistal and distal setae, 1 robust setae on inner distal angle and 3 on anterior face distally; outer plate somewhat surpassing second palp article, lined with stout setae distomarginally and mediomarginally; palp 4 articulate, 2nd article longest, 3rd article slightly expanded distally, 4th article with long unguis, slender.

Pereon. *Pereonite 1–6* dorsally, dorsolaterally and laterally smooth. *Pereonite 7* without carination, but posterior margin mid-dorsally serrate, with short mid-dorsal point; additional small mid-dorsal hump prior to posterior margin absent; posterolateral corner angular and not produced. *Gnathopod 1* (Fig. 3a, b, d) nearly rectipalmate; coxa slightly expanded distally, apex distally truncate, strongly directed anteriorly; basis longer than carpus; carpus subrectangular, with long setae along posterior margin (fine structure as in Fig. 3b); propodus palm transverse, defined by 1 serrate robust seta and additional robust seta; unguis curved. *Gnathopod 2* (Fig. 3c, e, i, j) coxa tapering distally; basis longer than carpus; carpus with serrate setae along distal half of the the posterior margin; propodus palm nearly oblique, defined by 1 serrate robust seta and 1 additional robust seta; dactylus of gnathopod 2 well developed, unguis short, less than or subequal to length of dactylus. *Pereopod 3* (Fig. 4a) coxa anterodistal lobe present, subacutely produced, surpassing posterior head margin, posterodistal lobe present, truncate, half the depth of the coxa, posterodistal margin smooth; basis slightly wider than ischium, long plumose setae on anterior and posterior margins; ischium subquadrate, 1/4 of merus length; merus, carpus, propodus subequal in length, setae on posterior margins; dactylus rather straight with slender unguis. Pereopod 3–4 coxa pelagont. *Pereopod 4* (Fig. 4b) coxa shorter than coxa 3, lobate in shape, curved posteriorly, posterior margin with well-developed lobe; ischium subquadrate, 1/4 of merus length; merus, carpus and propodus subequal in length, setae on posterior margins, dactylus rather straight, unguis slender. *Pereopod 5–7* (Fig. 5a–c) basis anterodistal corner weakly curved and pointed, posterior margin serrate. Pereopod 5 and 6 coxa bilobate, posterior lobe larger than anterior lobe; basis subovoid, expanded, posterodistal lobe weakly developed, not extending past ischium. *Pereopod 7* (Fig. 5c) coxa wider than long, posteroventrally pointed; basis oval, posterodistal lobe well developed, rounded, extending below ischium; merus drawn out posterodistally, merus, carpus and propodus successively longer, strongly setose antero- and posteromarginally; dactylus rather straight.

Pleon. *Pleonites 1–2* posterodorsal margin serrate, without carination, posterior margin mid-dorsally with short point.

Pleonite 3 (Fig. 1a) posterior margin mid-dorsally not produced, margin serrate. *Epimeron 1 and 2* posterior margin smooth, posterodistal corner weakly pointed. *Epimeron 3* (Fig. 1a) posterior margin serrate, smooth un-serrate, convex margin at dorsolateral part of epimeron; posteroventral corner rounded.

Urosomite 1 (Fig. 1a) mid-dorsal posterior margin serrate. *Urosomite 2* (Fig. 1a) mid-dorsal posterior margin serrate. *Urosomite 3* mid-dorsal posterior margin smooth. *Uropod 1* (Fig. 3f) peduncle with long distolateral process, longer than half the length of outer ramus; inner ramus longer than peduncle; apical robust setae on tip of both rami present. *Uropod 2* (Fig. 3g) peduncle with laterodistal process (much shorter and more bulky than that on peduncle of uropod 1) apical robust setae on tip of outer ramus present. *Uropod 3* (Fig. 3k) length exceeding uropods 1–2. *Telson* (Fig. 3h) almost reaching end of uropod 3 rami, 3 × as long as wide; with no setae along the lateral margin, without apical slender setae; lobes abutting, deeply cleft 90%.

Distribution. Atlantic Ocean, off Morocco, 460–888 m (type locality); New Zealand, Chatham Rise, Challeng-

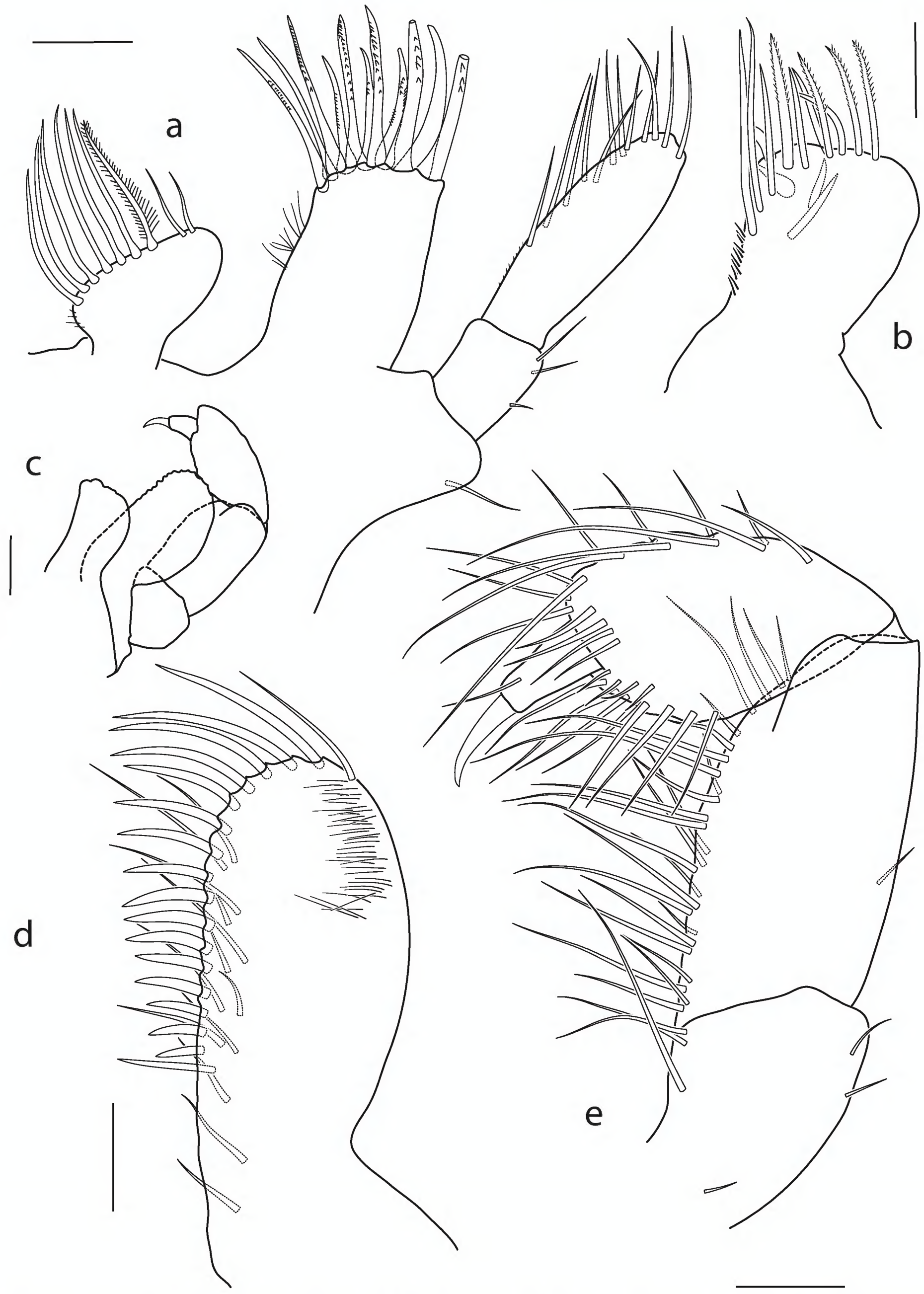

Figure 2. *Syrrhoe affinis*, male, 10 mm, ZMBN 127919. **a)** maxilla 1; **b)** inner plate of maxilliped; **c)** outlines of maxillipeds; **d)** outer plate of maxilliped; **e)** maxillipedal palp. Scale bars: 100 µm (**a–b, d–e**); 200 µm (**c**).

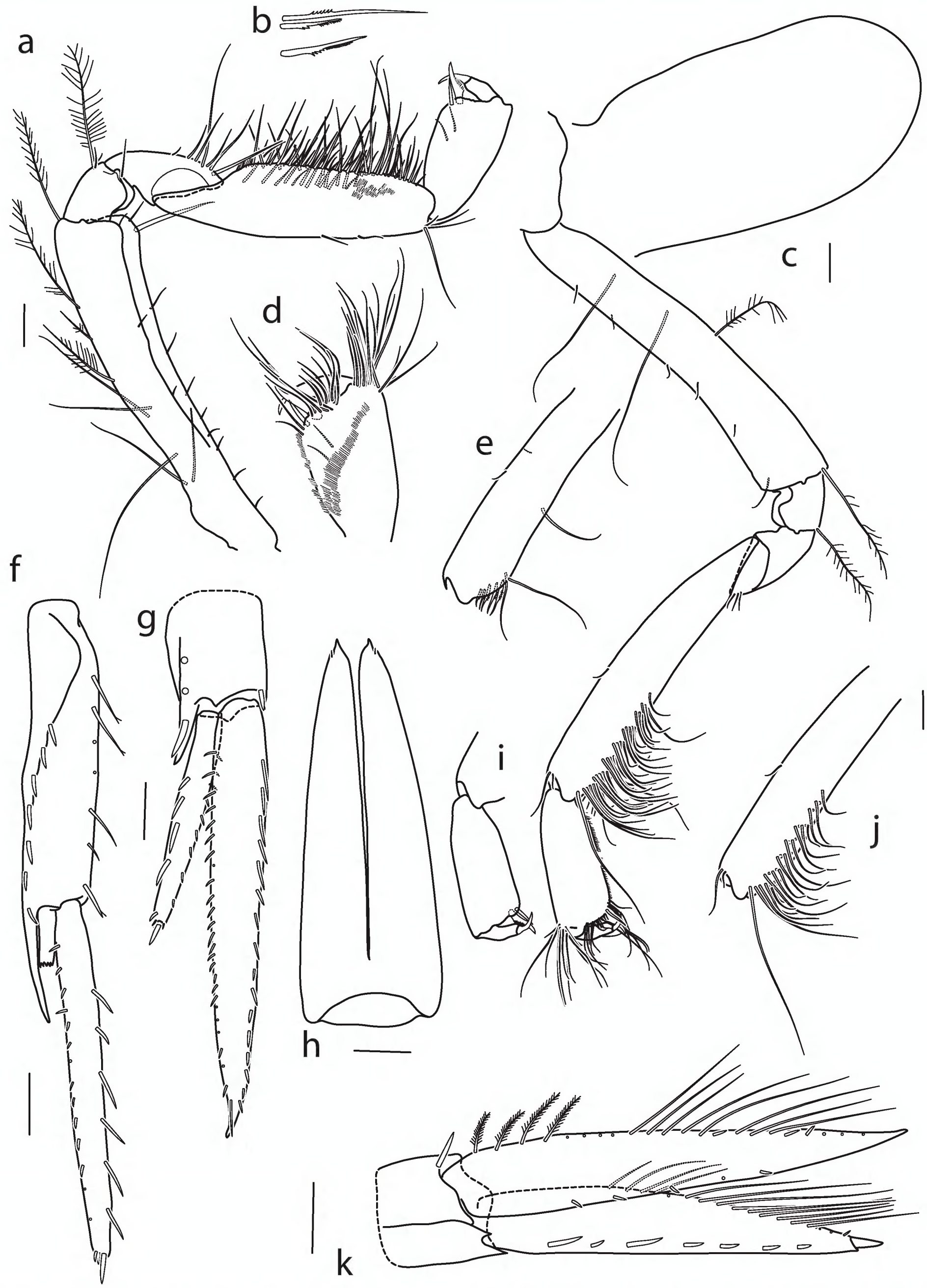

Figure 3. *Syrrhoe affinis*, male, 10 mm, ZMBN 127919. **a)** gnathopod 1, coxa not shown, setae of propodus omitted; **b)** details of setae from the posterior margin of carpus; **c)** gnathopod 2, coxa not shown; **d)** propodus and dactylus of gnathopod 1; **e)** carpus of gnathopod 2 showing medial setation; **f)** uropod 1, outer ramus damaged; **g)** uropod 2; **h)** telson; **i)** propodus and dactylus of gnathopod 2, setae omitted; **j)** carpus with lateral setation; **k)** uropod 3. Scale bars: 100 µm (**a, c, j**); 200 µm (**f, g, h, k**).

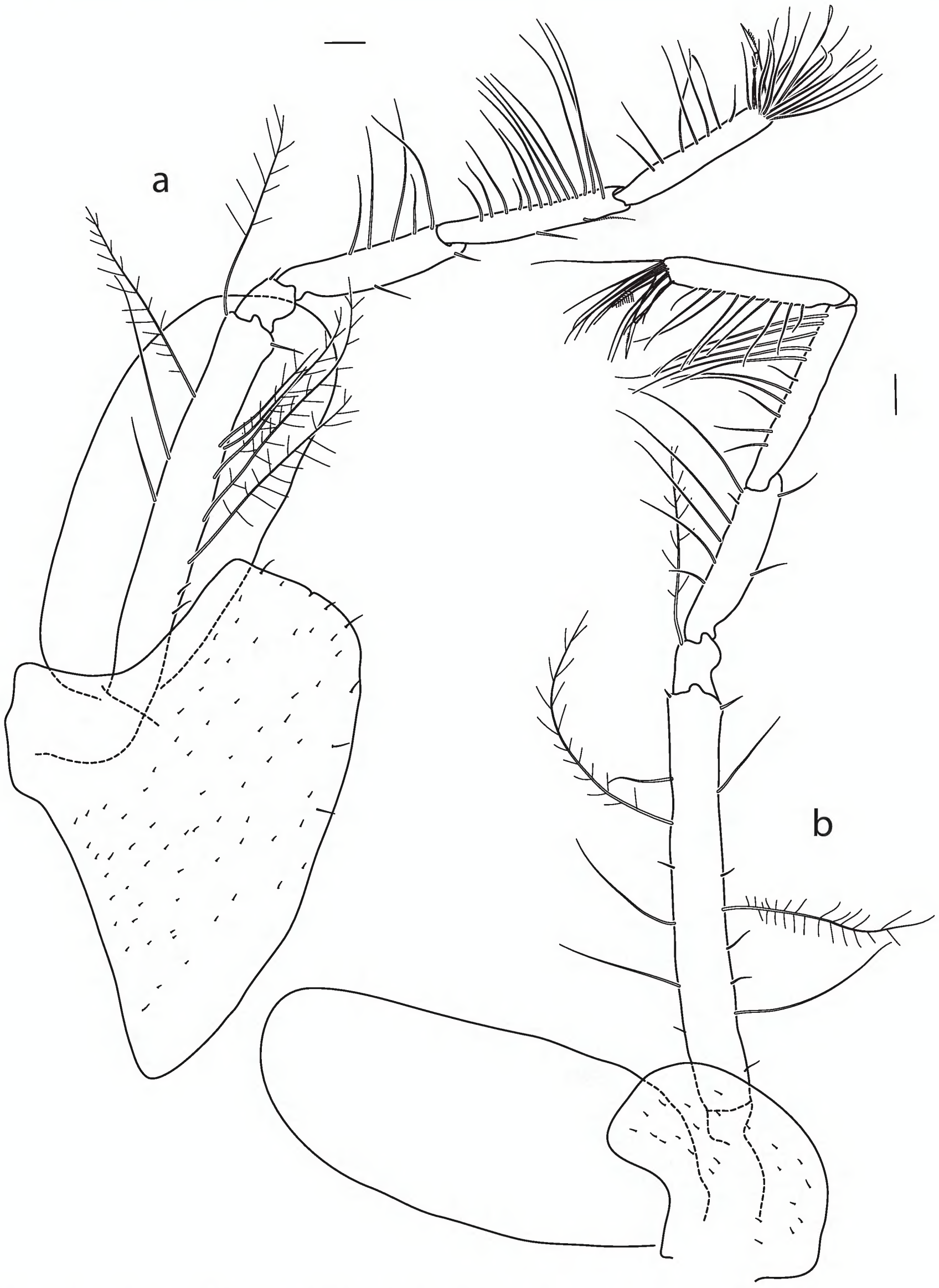

Figure 4. *Syrrhoe affinis*, male, 10 mm, ZMBN 127919. **a**) pereopod 3; **b**) pereopod 4. Scale bars: 100 µm.

er Plateau, Tasman Sea, 418–610 m; Mediterranean Sea, 180–360 m; Arctic North Atlantic, 193–569 m.

Remarks. Lörz and Coleman (2013) noted a morphological variance in the Pacific material of *S. affinis*, not related to sampling depth or gender of the animals, of larger specimens having a mid-dorsal long thin process on pereonites 7 and pleonites 1–2. This was also observed in the Arctic specimens studied herein.

This species was recorded by J.L. Barnard (1961) from New Zealand waters. Barnard placed a question mark before the species name as he doubted that a species originally described from the Atlantic coast off Morocco could occur in New Zealand waters. We share this hesitation, but could not detect any morphological differences in the material from Chevreux and material collected this century in the Pacific. Preserved specimens appear to have

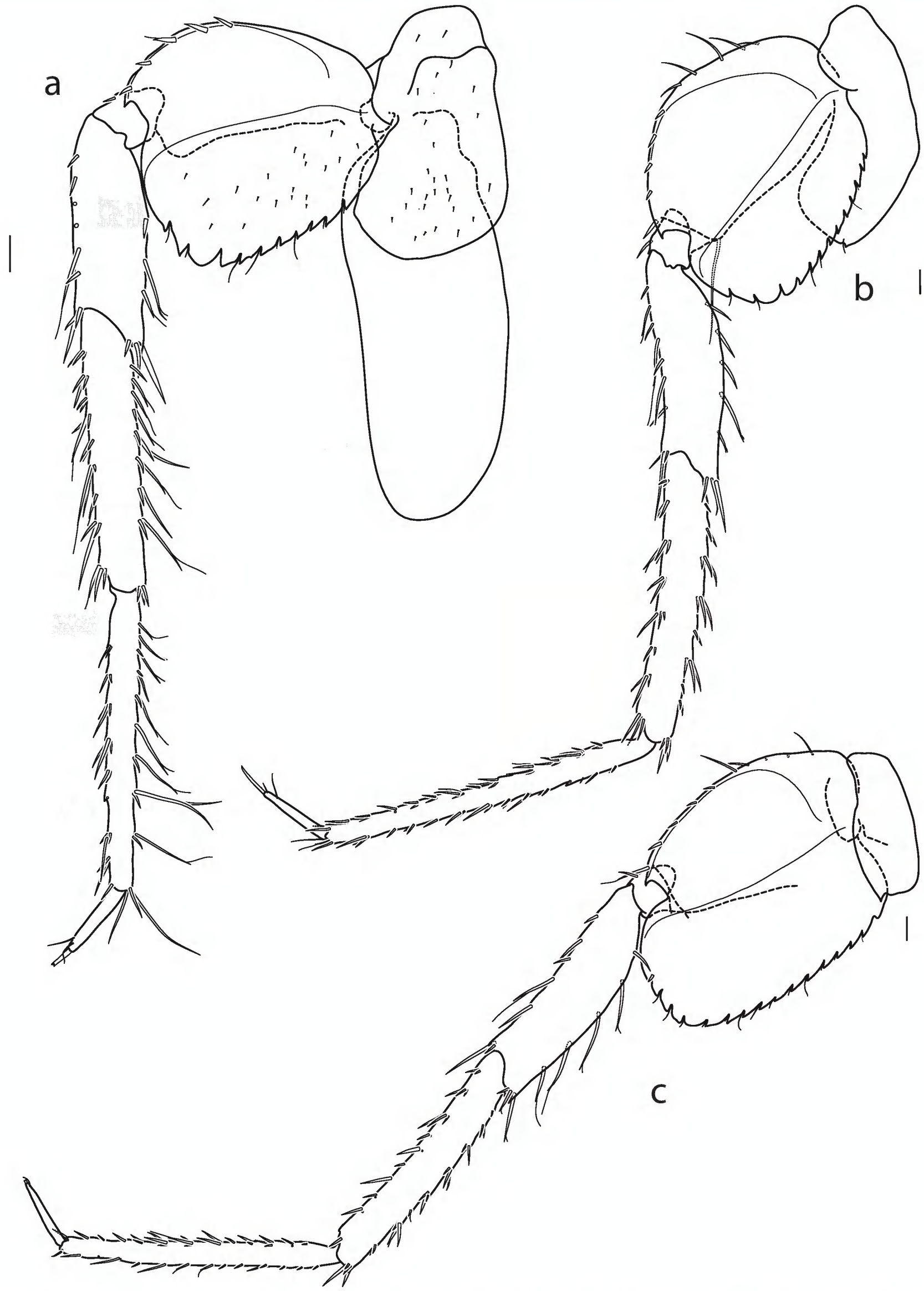

Figure 5. *Syrrhoe affinis*, male, 10 mm, ZMBN 127919. **a**) pereopod 5; **b**) pereopod 6; **c**) pereopod 7. Scale bars: 100 µm (**a–c**).

no eyes, there is not a trace of pigments but in some specimens of the Pacific material the outlines of eyes appear to be visible.

The present specimens of *S. affinis* from the North Atlantic differ minutely from the Pacific material by having urosomite 2 postero-dorsomarginally serrate (vs smooth), but the serration of urosomite 2 could have been less developed and therefore overlooked in populations from other regions. In Barnard's (1961) illustration of the Pacific material there is one tooth on this segment. In Ruffo (1993) the illustration of the Mediterranean material, identified as *S. affinis*, shows at least 2 teeth on this segment.

***Syrrhoe anneheleneae* sp. nov.**

http://zoobank.org/6B43618F-571D-4A45-9EE8-4F8903A2DD61

Figs 6–11

Material examined. Type material: 1 specimen, presumably subadult male, holotype, 9 mm, UNIS 2009 St. 12, AB 321, 79°1'2"N, 11°45'58"E, 232 m, 1.9.2009, RP sledge, ZMBN 112487; 5 paratypes, 2 females, 7.5 and 8 mm; 3 without sex determination, 7–8.7 mm, same as type locality, ZMBN 127920.

Additional material: 1 female, 2 specimens, without sex determination, Deutsche Expedition in das Nördliche Eismeer, 1898, St. 34, König Karls Land (Svalbard), leg. Römer & Schaudinn, ZMB 19834; 1 male, Deutsche Expedition in das Nördliche Eismeer, 1898, St. 47, Thymen Straße (Freeman Strait), 78°13'N 21°19'E, leg. Römer & Schaudinn, ZMB 19835; 3 specimens, without sex determination, UNIS 2015 St. 825, Svalbard, 78°8'55"N, 13°7'32"E, 243 m, 13.5.2015, RP sledge, ZMBN 112488; 3 specimens, without sex determination, UNIS 2009 St. 69, Svalbard, 81°1'46"N, 19°9'19"E, 174 m, 1.9.2009, RP sledge, ZMBN 112490; 1 specimen, without sex determination, UNIS 2009 St. 12 AB 321, Svalbard, 79°1'2"N, 11°45'58"E, 232 m, 1.9.2009, RP sledge, ZMBN 112486; 1 adult male, 10 mm, UNIS 2009, Adventfjord, 78°13'48"N, 15°33'36"E, 6.9.2009, RP sledge, ZMBN 112426; 1 specimen, without sex determination, UNIS 2015 St. 825, 78°8'55"N, 13°7'32"E, 243 m, 13.5.2015, RP sledge, ZMBN 112447; 3 males, 1 female, 2 specimens without sex determination, UNIS 2009 St. 50(2), Svalbard, 80° 6'31"N, 22°8'29"E, 216 m, 1.9.2009, RP sledge, ZMBN 112489; 12 males, 10 females, 211 without sex determination, UNIS 2015 St. 781, Kapp Mitra, 79°7'5"N, 11°5'E, 110 m, 8.5.2015, RP sledge, ZMBN 112451; 1 specimen ZMH-K 56185 (GenBank MK972331), 1 specimen ZMH-K 56186 (GenBank MK972330), 1 specimen ZMH-K 56187 (GenBank MK972327), East Iceland, Norwegian Sea, IceAGE st. 1219, 66°17.34'N, 12°20.8'W, 579 m, 22.09.2011.

Length ranges: females 7–9 mm, males 6–8 mm, without sex determination 4–9 mm.

Description based on: male holotype, 9 mm, ZMBN 112487.

Head. Rostrum reaching half the length of article 1 of antenna 1; lateral cephalic lobe present, pointed; *eyes* present, large, oval, on dorsal part of head, unpigmented (Fig. 6a, b). *Antenna 1* (Fig. 6e) article 1 with 2 teeth of different length, 1 large distally curved tooth and 1 shorter and straight tooth; article 2 without distomedial tooth, slightly shorter than article 1; article 3 somewhat shorter than article 2; accessory flagellum 3-articulate, surpassing 3rd flagellar article, 3rd article of accessory flagellum less than a quarter length of 1st accessory flagellar article; flagellum shorter than pereon, 14 articles. *Antenna 2* (Fig. 7a) longer than antenna 1, not surpassing pereon; article 5 longest; flagellum 13-articulate, shorter than peduncle. *Labrum* (Fig. 6c) apically rounded, tapering distally. *Mandible* (Fig. 7b, c, d) incisor multidentate; left lacinia mobilis wide and multidentate; accessory setal row with 5 weakly denticulate setae; molar small, columnar, weakly triturative; palp article 1 smooth, shorter than half the length of article 2, article 2 with slender setae; article 3 half the length of article 1, with long 6 slender setae apically. *Lower lip* (Fig. 6d) with wide gap; inner lobes present, outer lobes apically setose; hypopharyngeal lobes wide. *Maxilla 1* (Fig. 7e) inner plate with 8 plumose setae; outer plate with 11 apical robust setae; bifurcate setae present; palp article 2 outer margin smooth, with apical and medial setation. *Maxilla 2* (Fig. 7f) inner plate width about 2 × outer plate, with row of facial setae. *Maxilliped* (Fig. 8a–e) inner plate reaching 1st palp article, with 10 strong setae; outer plate distally and medially with simple robust setae; palp article 2 is 1.5 × the length of article 3; palp article 3 slightly inflated; article 4 weakly curved, with long unguis.

Pereon. *Pereonite 1–6* dorsally, dorsolaterally and laterally smooth (Fig. 6a). *Pereonite 7* posterior margin mid-dorsally serrate, with short point; posterolateral corner angular and not produced. *Gnathopod 1* (Fig. 9a) coxa not tapering distally, apex strongly directed anteriorly; basis longer than carpus; carpus subrectangular, with smooth setae along the posterior margin; propodus palm transverse, defined by 1 serrate robust seta. *Gnathopod 2* (Fig. 9b) coxa distally tapering; basis twice the length of carpus; carpus serrate setae along the posterior margin at ventral part; propodus palm nearly oblique, defined by 1 serrate robust setae; dactylus of gnathopod 2 well developed, unguis similar length to dactylus. *Pereopod 3* (Fig. 10a) coxa anterodistal lobe present, obliquely produced, posterodistal lobe present, truncate, half the depth of the coxa, posterodistal margin with minute setae; basis width equal to breadth of ischium; ischium subquadrate, 1/4 of merus length; dactylus weakly curved. *Pereopod 3–4* coxa pelagont. *Pereopod 4* (Fig. 10b) coxa much shorter than coxa 3, lobate in shape, slightly curved posteriorly; ischium subquadrate, 1/4 of merus length; dactylus weakly curved. *Pereopod 5–7* (Fig. 11a–c) basis anterodistal corner weakly produced into a recurved hook, posterior margin strongly serrate. *Pereopod 5–6* basis subovoid, expanded, posterodistal lobe weakly developed, not extending past ischium. *Pereopod 7* basis ovate, posterodistal lobe well developed, rounded, extending below ischium.

Pleon. *Pleonite 1–3* (Fig. 6a) dorsally round, without carination, posterior margin serrate and mid-dorsally with short point. *Epimeron 1* posterior margin smooth, posterodistal corner weakly pointed. *Epimeron 2* posterior margin smooth, posterodistal corner pointed. *Epimeron 3* posterior margin serrate, posteroventral corner subquadrate.

Pleopod (Fig. 11d) rami similar length, 13 and 15 articles, all articles with setulated setae.

Urosomite 1 (Fig. 6a) mid-dorsal posterior and lateral margin serrate. *Urosomite 2* (Fig. 6a) mid-dorsal posterior margin smooth. *Urosomite 3* (Fig. 6a) mid-dorsal posterior margin smooth.

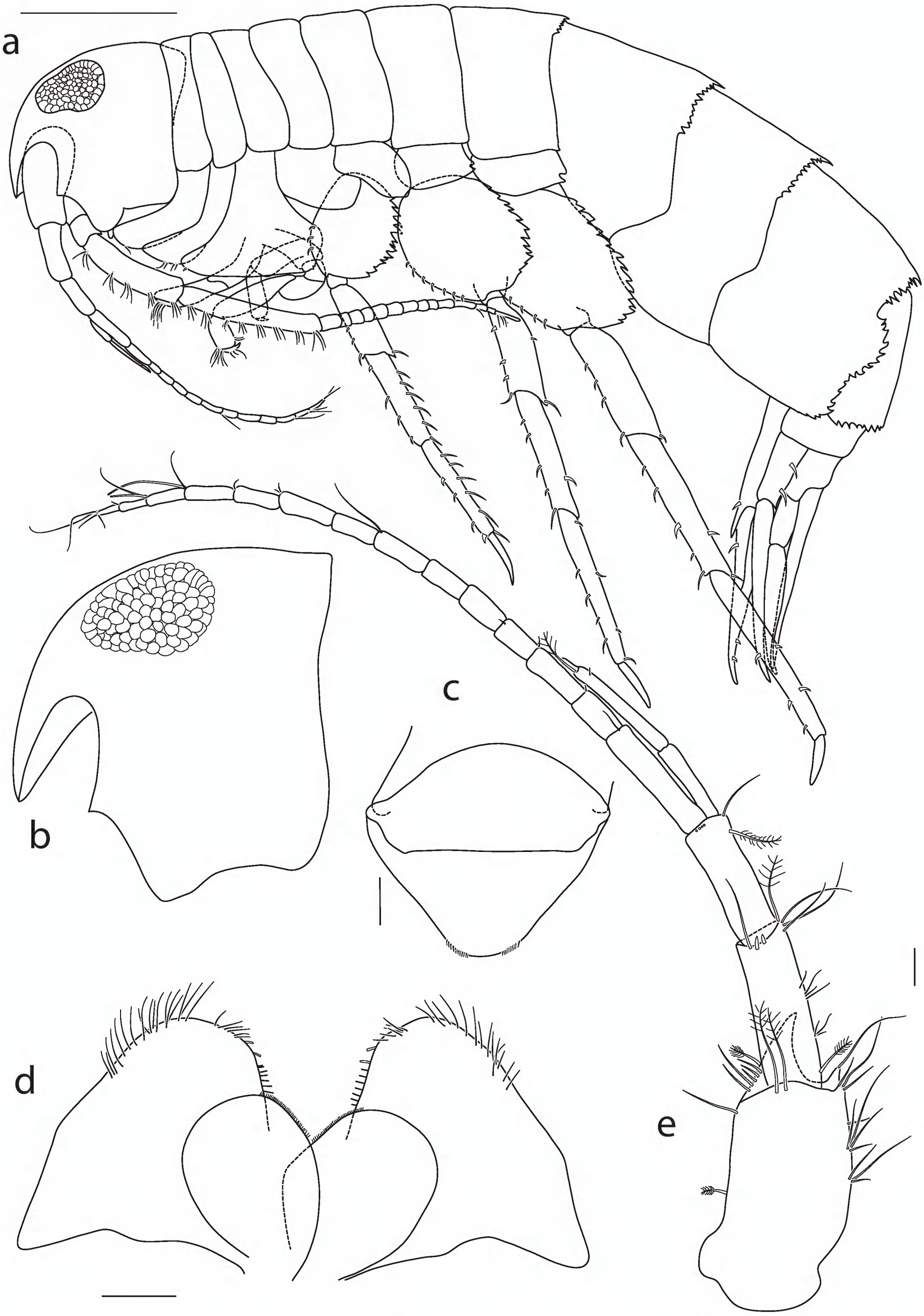

Figure 6. *Syrrhoe anneheleneae* sp. nov., male holotype, 9 mm, ZMBN 112487. **a**) habitus; **b**) head; **c**) upper lip (labrum); **d**) lower lip; **e**) antenna 1. Scale bars: 1 mm (**a**); 100 µm (**c**–**e**).

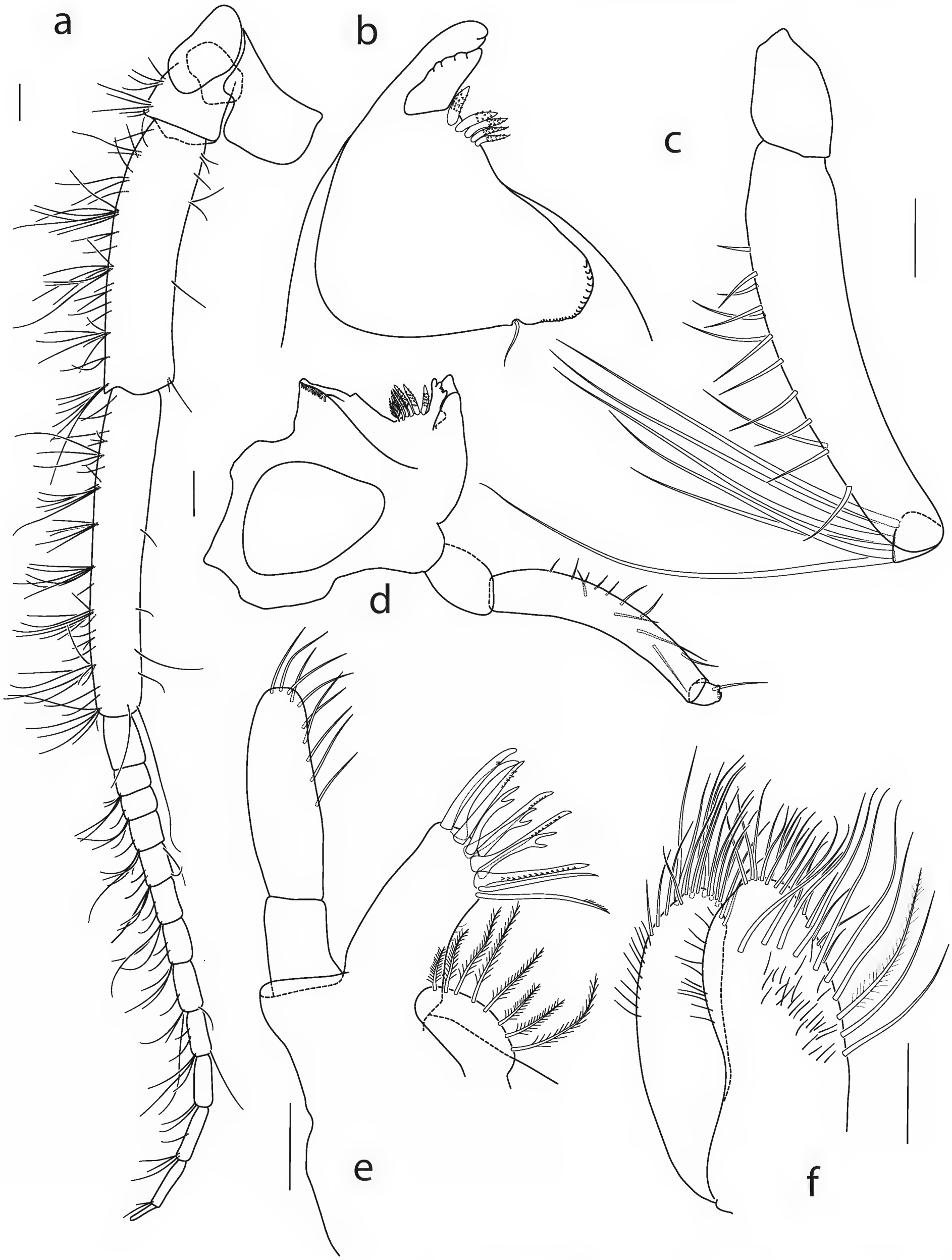

Figure 7. *Syrrhoe anneheleneae* sp. nov., male holotype, 9 mm, ZMBN 112487. **a**) antenna 2; **b**) mandible; **c**) mandibular palp; **d**) mandible; **e**) maxilla 1; **f**) maxilla 2, setulation shown on one exemplary seta. Scale bars: 100 µm (**a–f**).

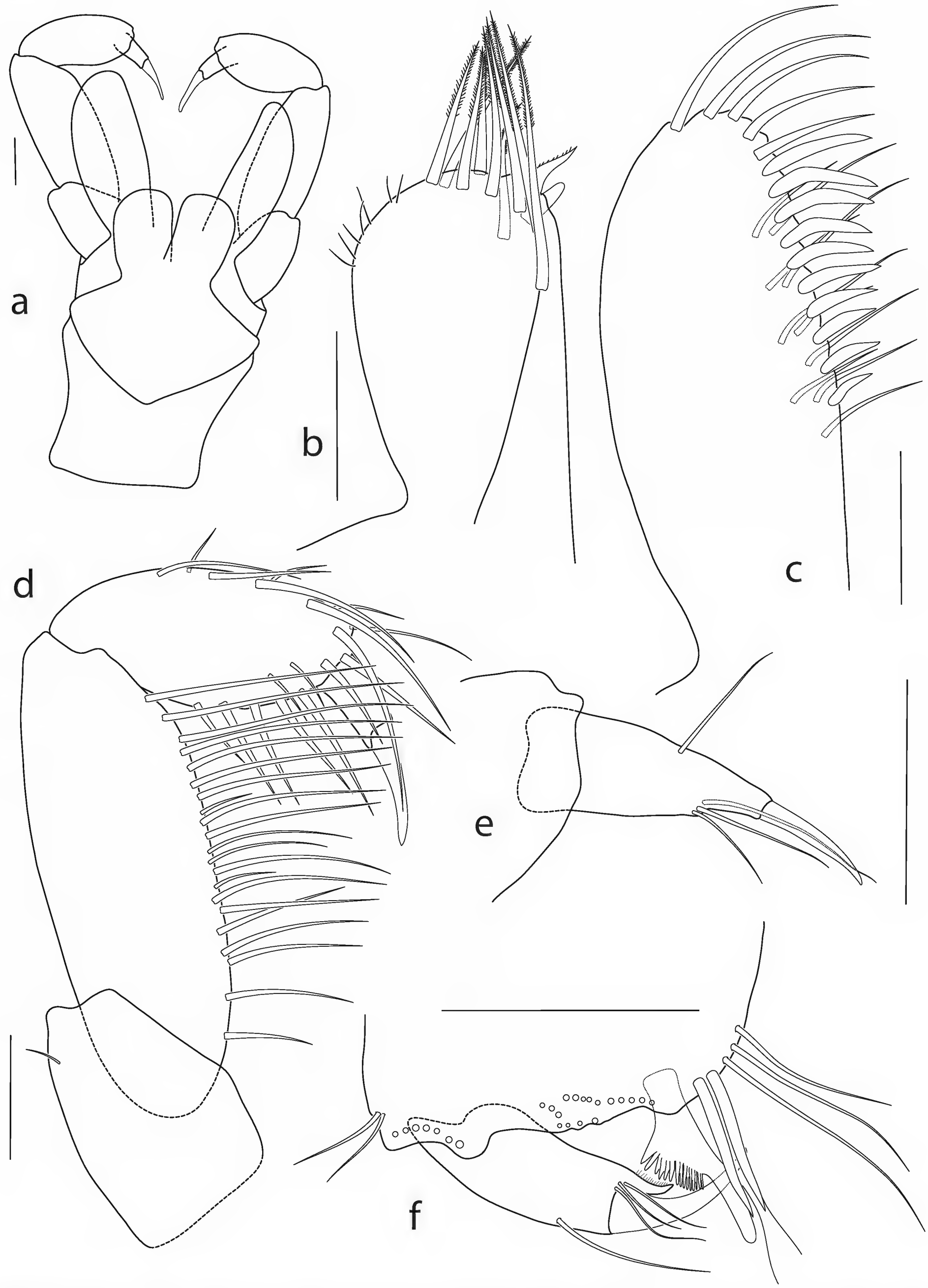

Figure 8. *Syrrhoe anneheleneae* sp. nov., male holotype, 9 mm, ZMBN 112487. **a**) outlines of maxilliped; **b**) inner plate of maxilliped; **c**) outer plate of maxilliped; **d**) maxillipedal palp; **e**) dactylus of maxillipedal palp; **f**) chela of gnathopod 1. Scale bars: 100 µm (**a–f**).

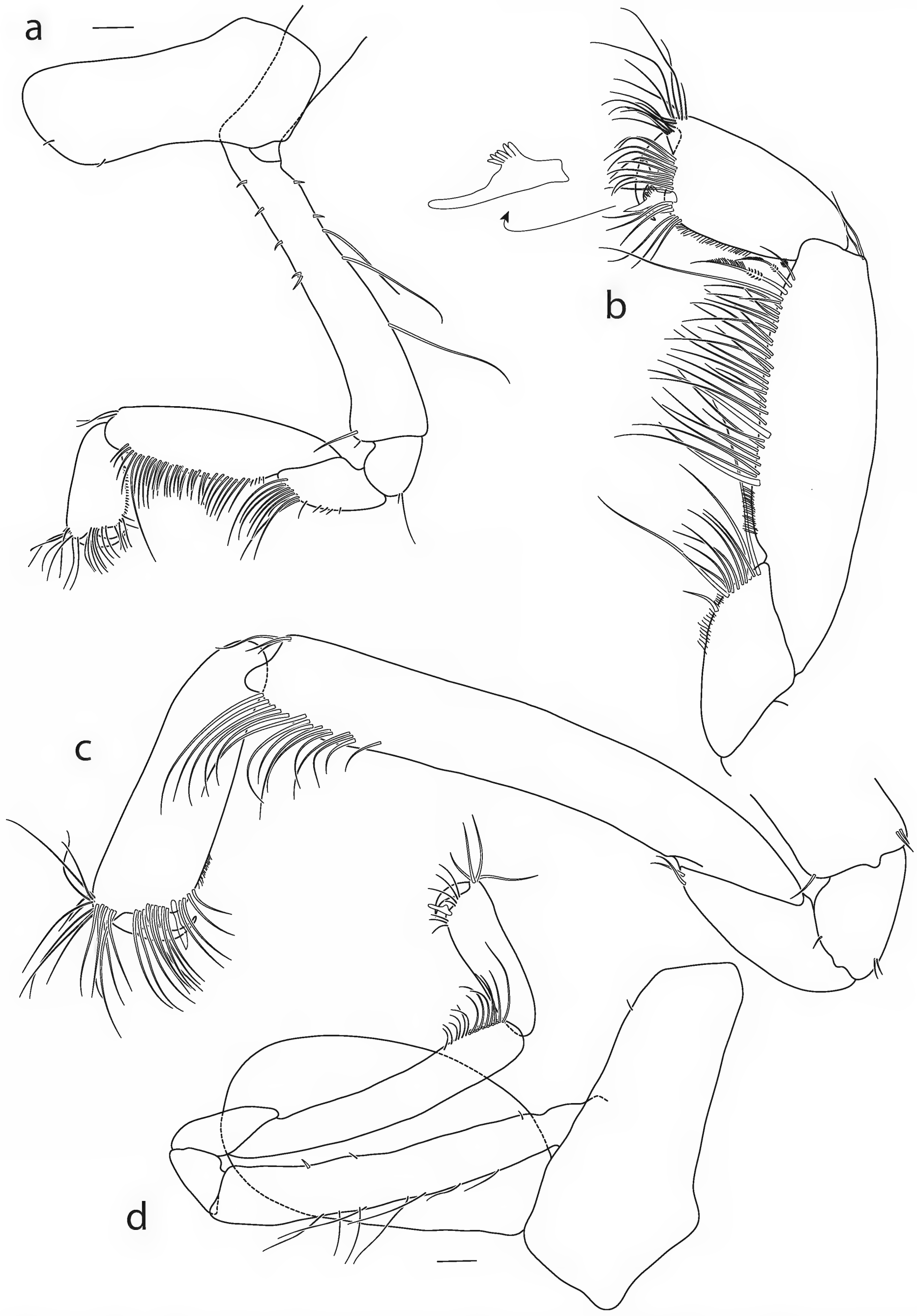

Figure 9. *Syrrhoe anneheleneae* sp. nov., male holotype, 9 mm, ZMBN 112487. **a)** gnathopod 1; **b)** merus to dactylus of gnathopod 1; **c)** ischium to dactylus of gnathopod 2; **d)** gnathopod 2. Scale bars: 100 µm (**a, b, d**).

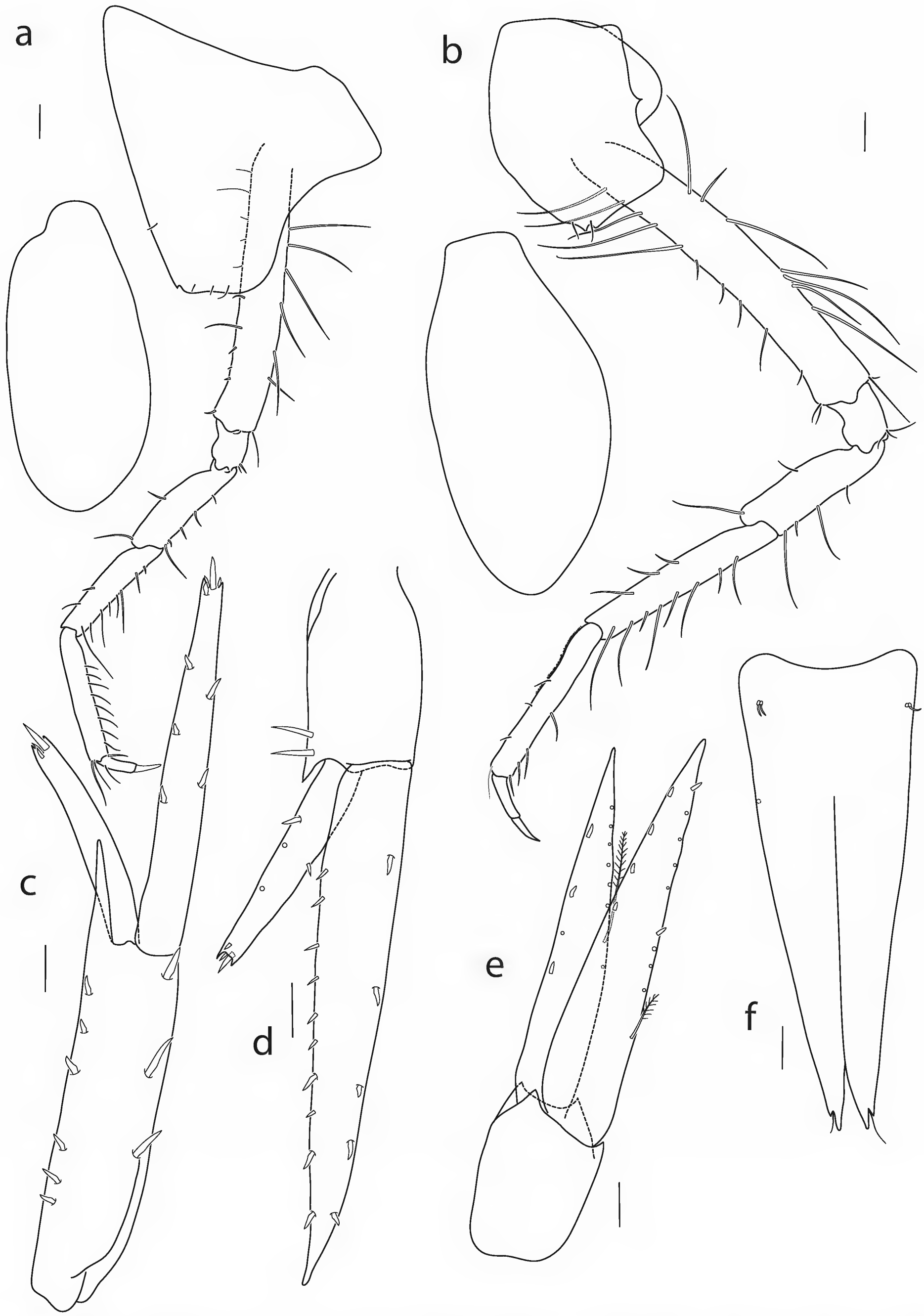

Figure 10. *Syrrhoe anneheleneae* sp. nov., male holotype, 9 mm, ZMBN 112487. **a**) pereopod 3; **b**) pereopod 4; **c**) uropod 1; **d**) uropod 2; **e**) uropod 3, **f**) telson. Scale bars: 100 µm (**a–f**).

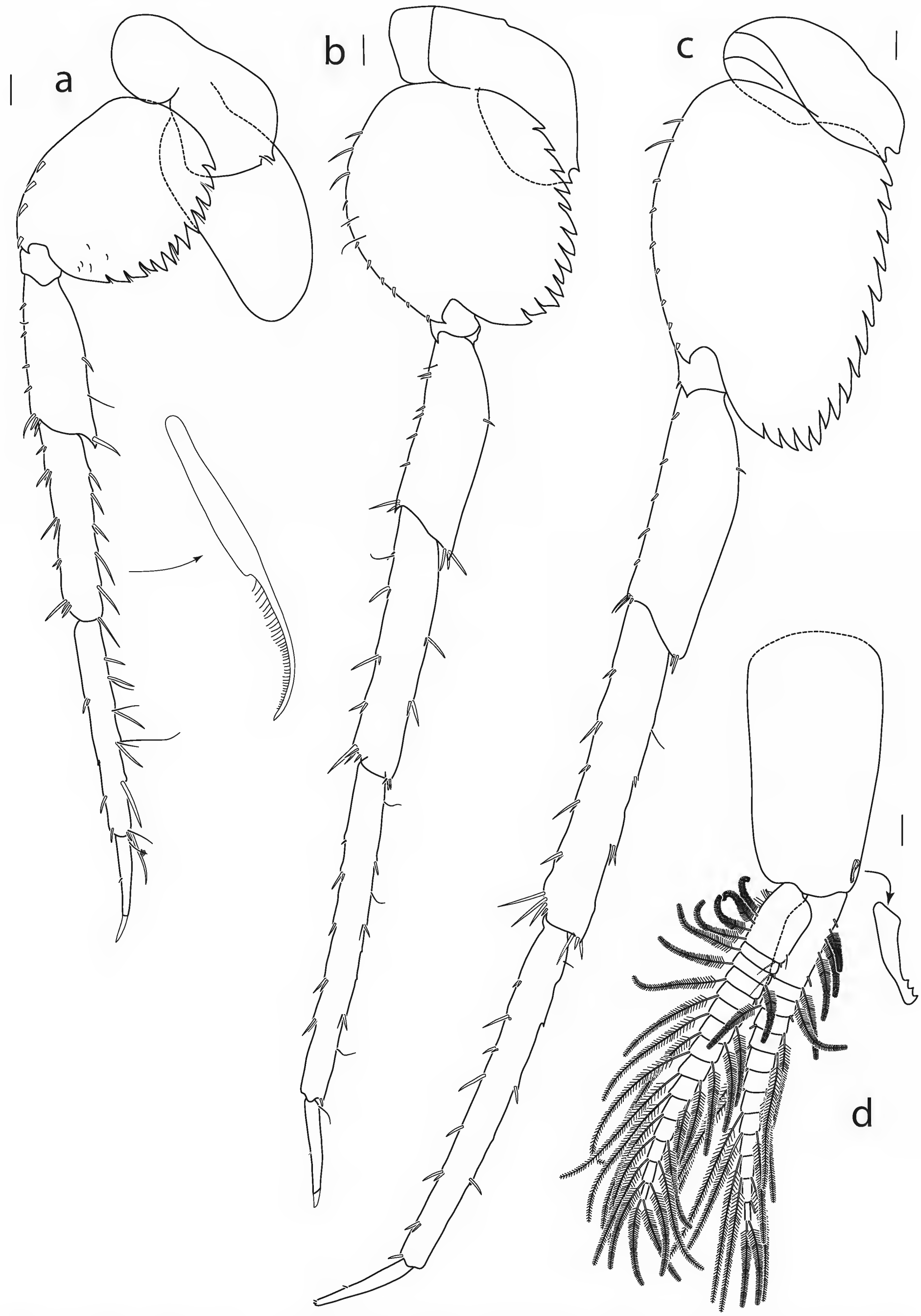

Figure 11. *Syrrhoe anneheleneae* sp. nov., male holotype, 9 mm, ZMBN 112487. **a**) pereopod 5; **b**) pereopod 6; **c**) pereopod 7; **d**) pleopod 1. Scale bars: 100 µm (**a–d**).

Uropod 1 (Fig. 10c) peduncle with long distal process, the process reaching half the length of outer ramus; inner ramus same length as peduncle; apical robust setae on tip of both rami present. *Uropod 2* (Fig. 10d) apical robust setae on tip of outer ramus present, outer ramus half the length and half the with of inner ramus. *Uropod 3* (Fig. 10d) length not exceeding uropods 1–2, outer ramus 2.5 × length of peduncle. *Telson* (Fig. 10f) almost as long as uropod 3 peduncle, 3 × as long as wide; with no setae along the lateral margin, with apical slender setae; lobes abutting, deeply cleft, more than 75%.

Distribution. North Atlantic, 110–579 m.

Etymology. Named for Dr. Anne Helene Tandberg, great amphipodologist and a friend of the authors, who organized the wonderful workshop in Bergen, where the new species was discovered.

Remarks. *Syrrhoe anneheleneae* sp. nov. is rather similar to *Syrrhoe crenulata*. Both species have a narrow straight to excavate space between the dorsal serration and the serration of the epimeron 3. *Syrrhoe anneheleneae* sp. nov. has a serrate margin of urosomite 1 (vs. smooth in *S. crenulata*) and in ethanol white eyes (vs. dark pigmented in *S. crenulata*). A serration on urosomite 1 also occurs in *S. papyracea* Stebbing, 1888, but this species, only known from the type locality Culebra Island, Porto Rico (Shoemaker 1935), differs in several respect from *S. anneheleneae* sp. nov.: head anteriorly produced; no eyes present; epimeral plates without posteromarginal serration and the palm of both gnathopods has an additional stout spine aside the serrate spine.

Syrrhoe crenulata Goës, 1866

Figs 12–17

Syrrhoe crenulata Goës, 1866, p. 527, fig. 25. – G.O. Sars 1895, p. 390, pl. 136. – Stebbing 1906, p. 282. – Shoemaker 1930, p. 73. – Stephensen 1931, p. 157, chart 47. – Stephensen 1931, p. 234. Shoemaker 1955, p. 39. – J.L. Barnard 1971, p. 74. J.L. Barnard 1972, p. 53

Material examined. 1 female, 10 mm, MAREANO 2013, R1218-471, 70°34'57"N, 30°56'37"E, 155–157 m, 17.8.2013, beamtrawl, ZMBN 127922; 1 female, Sabine Island, 74°36'N 18°59'W, 7–18 m, leg. Pansch, ZMB 4699; 6 females, IceAGE st. 1090, 66°0.03'N 25°3.18'W, 742.5 m, 10.9.2011, R/V Meteor, epibenthos sledge, ZMB 31710; 1 specimen ZMH-K 56188 (GenBank MK972328), 1 specimen ZMH-K 56189 (GenBank MK972329), North west Iceland, Denmark Strait, IceAGE st. 1104, 66°38.60'N, 24°31.97'W, 119 m depth, 13.09.2011.

Description based on: female, with un-setose oostegites, 10 mm, ZMBN 127922.

Head. Head anteriorly not produced, rounded. Rostrum reaching about half of antenna 1 article 1; lateral cephalic lobe pointed; eyes present, with dark pigmentation (present in 5 year old ethanol sample), large, oval, on dorsal part of head.

Antenna 1 (Fig. 12d) article 1 not elongate, with 2 distal curved teeth of about the same length; article 2 without distomedial tooth, longer than article 1; article 3 shorter than article 1 and 2; accessory flagellum surpassing 3rd flagellar article, accessory flagellum 2nd article as long as first flagellar article, 3rd article less than a quarter length of 1st accessory flagellar article; flagellum 19-articulate. *Antenna 2* (Fig. 12b) 5th peduncular article longest; flagellum 12-articulate.

Mandible (Fig. 12c) incisor multidentate; left lacinia mobilis wide and multidentate; setal row with 6 pappose setae; molar large, triturative; mandibular palp (Fig. 12c) article 2 with many slender setae on ventral margin; article 3 a tenth of the length of article 2 (knob-like), with 6 long slender setae, considerably longer than those of article 2. *Maxilla 1* (Fig. 13b) inner plate with 10 long and 2 short plumose setae; outer plate with 11 apical robust setae, some of them are bifurcate; palp article 2 outer margin smooth, with apical and medial setation. *Maxilla 2* (Fig. 13a) inner plate width more than 1.3 × outer plate, inner plate with row of stout facial setae. *Maxilliped* (Figs 13c–e; 14a–b) inner plate with 2 stout setae distally and a hook-like robust seta on disto-medial anterior face; outer plate not quite reaching apex of 2nd palp article, medially lined with rather long robust setae and slender setae submarginally; palp (Figs 13c, 14b) article 2 1.7 × the length of article 3; palp article 3 slightly inflated, 4th article curved, with a long unguis.

Pereon. *Pereonites 1–6* posteromarginally smooth. *Pereonite 7* dorsally rounded, not carinate, posterior margin smooth except for mid-dorsal marginal little point; posterolateral corner slightly produced.

Gnathopod 1 (Figs 14c, 15a) coxa, proximally wider than apically, subrectangular with obliquely truncate apex; basis longer than coxa; merus tapering, with group of setae on posterodistal margin; carpus subrectangular (posteriorly slightly expanded), with smooth setae along the posterior margin; propodus palm transverse, defined by 1 serrate robust seta, additional smooth robust setae absent; dactylus extending to palm margin. *Gnathopod 2* (Figs 15b, c, 16a) coxa not distally tapering, apex oblique; basis longer than carpus; propodus palm transverse, slightly oblique, defined by 1 serrate robust seta, additional smooth robust smooth setae absent; dactylus well developed. *Pereopod 3* (Fig. 16f) coxa anterodistal lobe present, produced subacutely rounded, posterodistal lobe present, rounded, half the depth of the coxa, posterodistal margin smooth; basis width slightly wider than ischium; ischium subrectangular, a third as long as merus; propodus longest; merus, carpus and propodus setae on posterior margin; dactylus only weakly curved. Pereopod 3–4 coxa pelagont. *Pereopod 4* (Fig. 16b) coxa shorter than coxa 3, slightly curved posteriorly; ischium subrectangular, a third as long as merus; merus, carpus and propodus setae on posterior margin; dactylus very weakly curved. *Pereopod 5–7* (Fig. 17a–c) coxa posteromarginally notched. Pereopod 5–7 basis anterodistal corner produced as a recurved hook, posterior margin strongly

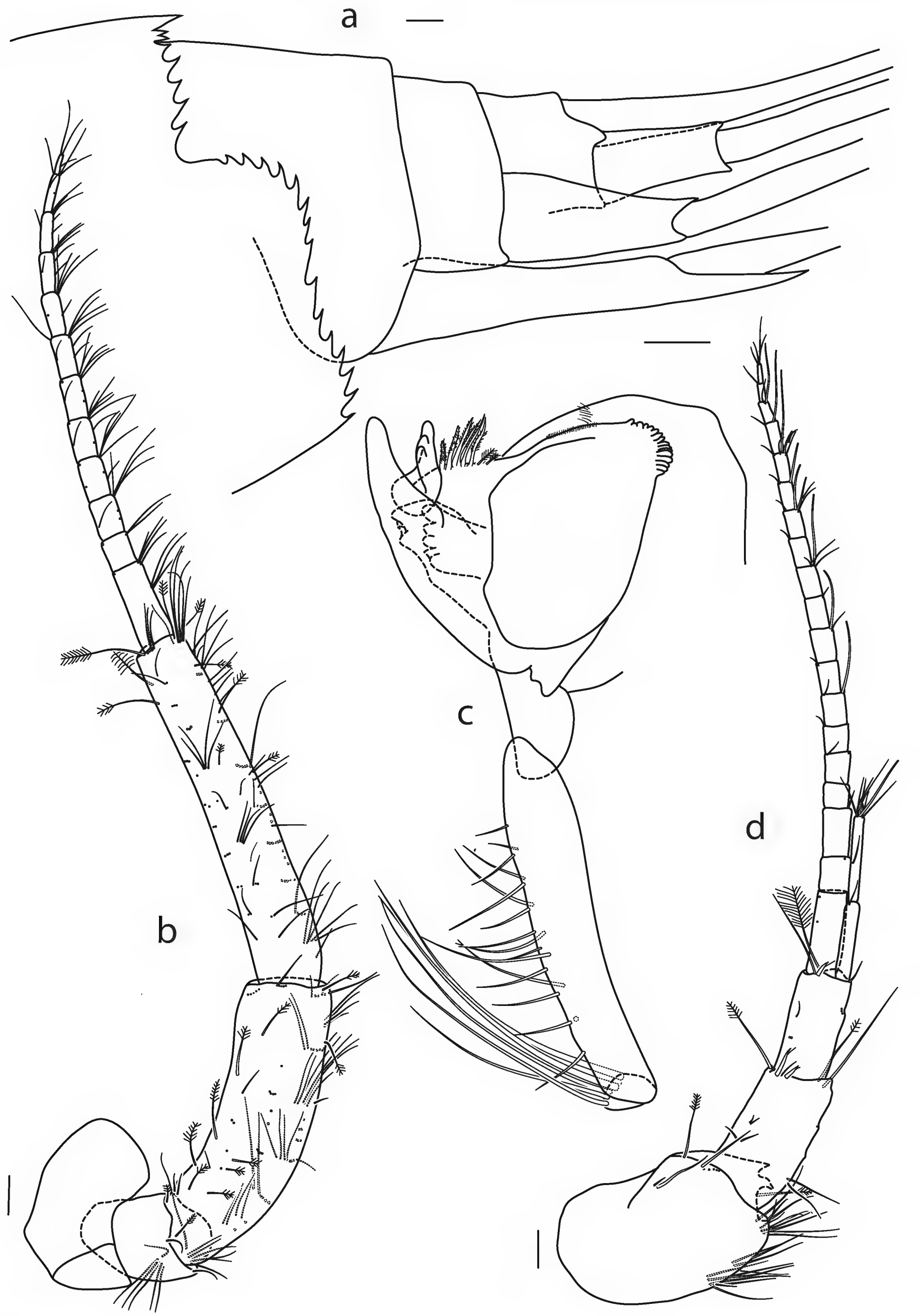

Figure 12. *Syrrhoe crenulata*, female, 10 mm, ZMBN 127922. **a**) pleonite 3 and urosome; **b**) antenna 2; **c**) mandible; **d**) antenna 1. Scale bars: 100 μm (**a–d**).

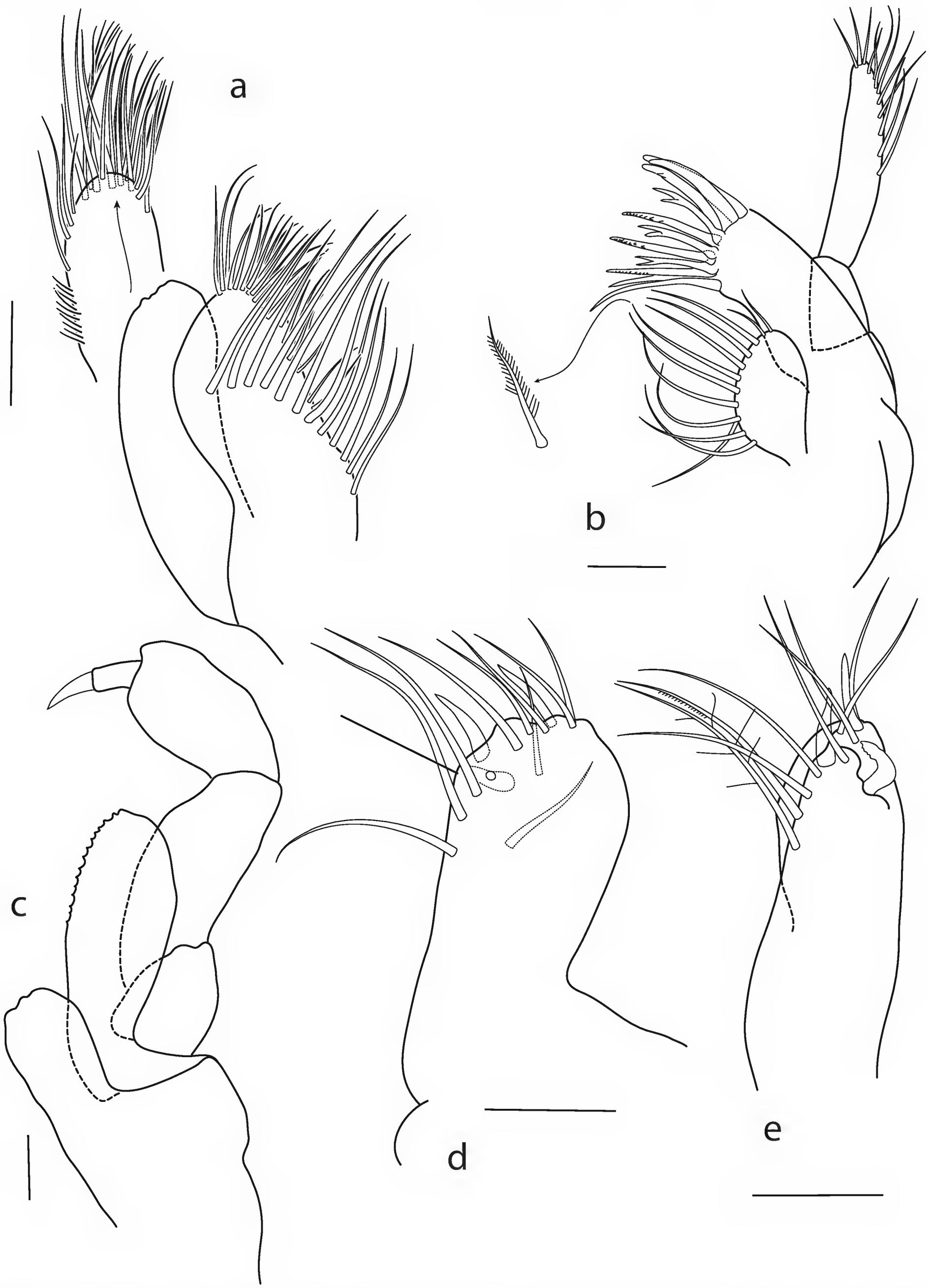

Figure 13. *Syrrhoe crenulata*, female, 10 mm, ZMBN 127922. **a)** maxilla 2; **b)** maxilla 1; **c)** outlines of maxilliped; **d)** inner plate of of maxilliped; **e)** inner plate of of maxilliped. Scale bars: 100 µm (**a–e**).

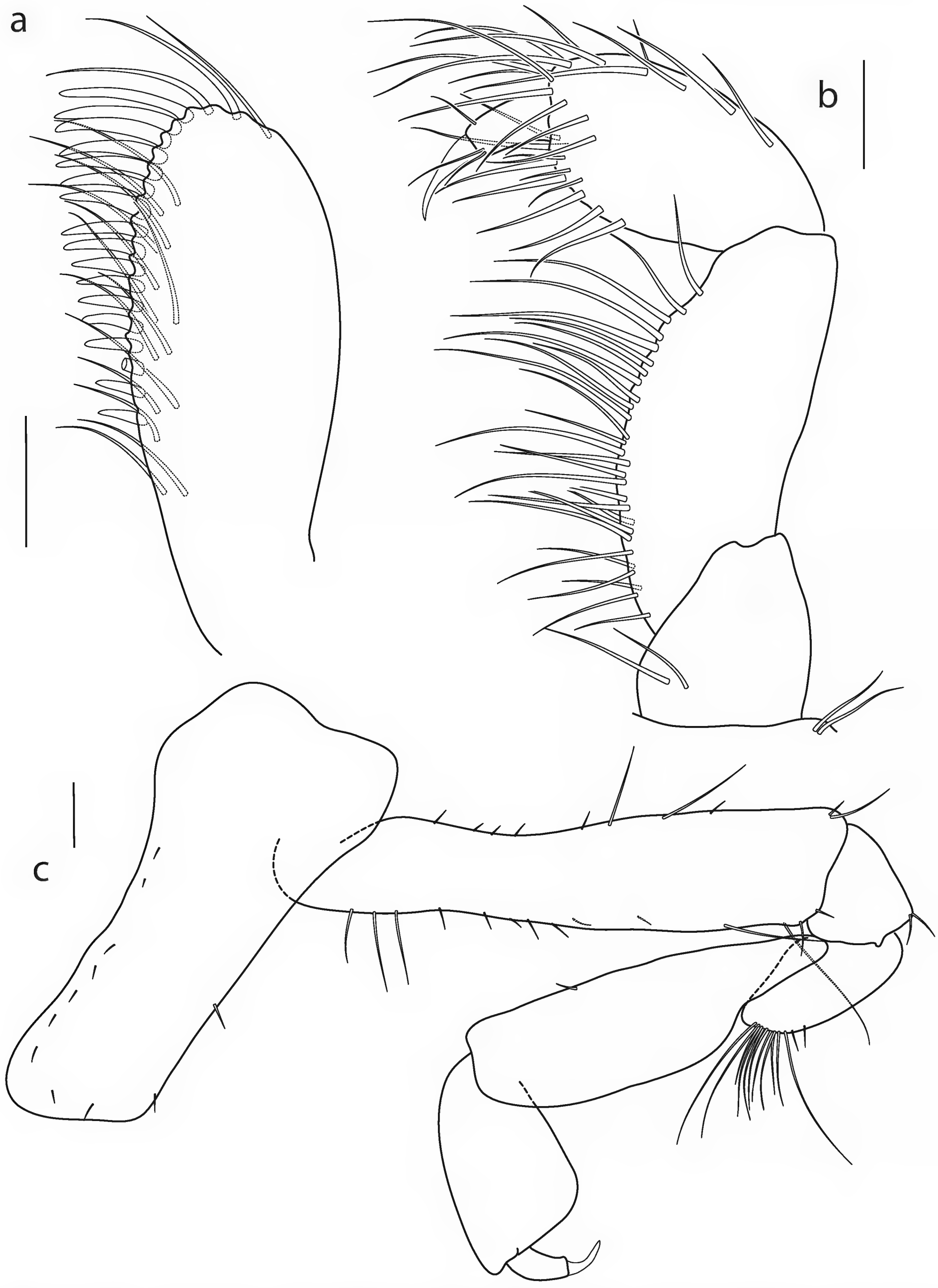

Figure 14. *Syrrhoe crenulata*, female, 10 mm, ZMBN 127922. **a**) outer plate of maxilliped; **b**) maxillipedal palp; **c**) gnathopod 1, setae omitted. Scale bars: 100 µm (**a–c**).

Figure 15. *Syrrhoe crenulata*, female, 10 mm, ZMBN 127922. **a**) merus to dactylus of gnathopod 1; **b**) gnathopod 2, setae omitted on merus to dactylus; **c**) chela of gnathopod 2. Scale bars: 100 µm (**a–b**).

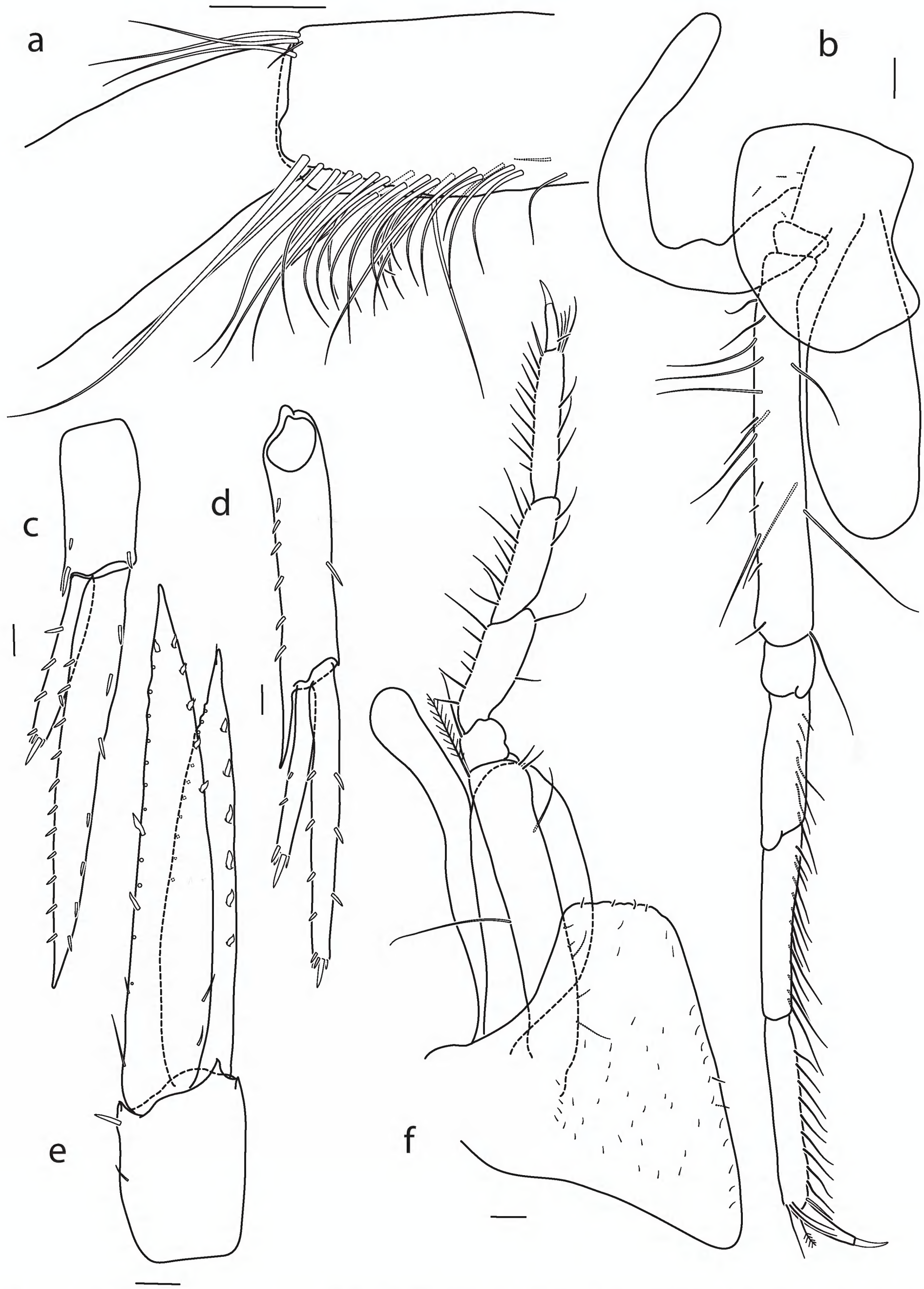

Figure 16. *Syrrhoe crenulata*, female, 10 mm, ZMBN 127922. **a**) setation of posterodistal part of carpus, **b**) pereopod 4; **c**) uropod 2, **d**) uropod 1; **e**) uropod 3; **f**) pereopod 3. Scale bars: 100 µm (**a–f**).

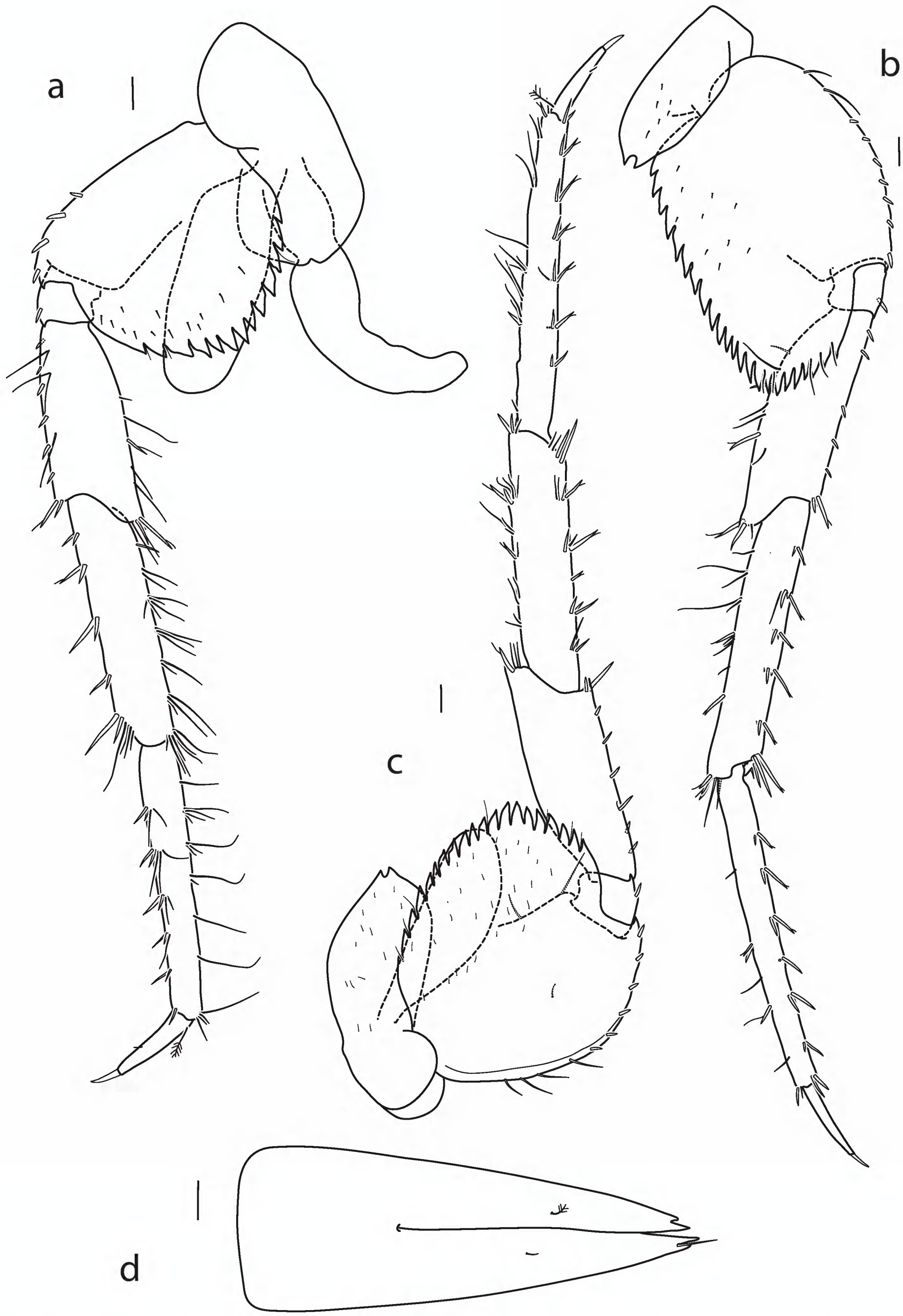

Figure 17. *Syrrhoe crenulata*, female, 10 mm, ZMBN 127922. **a**) pereopod 5; **b**) pereopod 7; **c**) pereopod 6; **d**) telson. Scale bars: 100 µm (**a–d**).

serrate. *Pereopod 5* basis subovoid, expanded, posterodistal lobe well developed, rounded, not extending past ischium. *Pereopod 6–7* basis ovate, posterodistal lobe well developed, rounded extending below ischium.

Pleon. *Pleonite 1–3* serrate posteromarginally and a middorsal short point. *Epimeron 1–2* posteroventrally acute. *Epimeron 3* (Fig. 12a) posterior margin and dorsally of posteroventral corner serrate, ventral margin serration absent, posteroventrally angular.

Urosomite 1–3 dorsal and lateral margins smooth. *Uropod 1* (Fig. 16d) peduncle with long laterodistal process, at least 1/3 of length of outer ramus; inner ramus longer than peduncle; apical robust setae on tip of both rami. *Uropod 2* (Fig. 16c) outer ramus half the length of inner ramus, outer ramus bearing apical robust setae on the tip. *Uropod 3* (Fig. 16e) length not exceeding uropods 1–2; peduncle short (less than 2 × breadth). *Telson* (Fig. 17d) almost as long as uropod 3 rami, more than 3 × as long as wide, cleft more than 66%.

Distribution. Circum-Arctic and northern boreal: off Oregon; Newfoundland; Massachusetts; Gulf of St. Lawrence; Maine; North Atlantic; North Sea; Norwegian Coast, Skagerak; Spitsbergen; East and West Greenland; Arctic Ocean, 7–742.5 m. These distributional records from the literature were not checked with the original material they are based on. Due to the close resemblance of *S. crenulata* and *S. anneheleneae* sp. nov. a mix-up between these species and their occurrence cannot be excluded.

Remarks. There are two habitus characters that discriminate *Syrrhoe crenulata* from the other two North Atlantic *Syrrhoe* species: the posterior margins of its urosomites 1 and 2 are smooth with no trace of serration and the eyes are present and have a rather dark brownish pigmentation, which is detectable even in old ethanol material (vs. no eyes visible in *S. affinis* and white (in ethanol), apparently unpigmented eyes in *S. anneheleneae* sp. nov.). The former subspecies from the Antarctic species *Syrrhoe crenulata psychrophila* Monod, 1926 has been raised in rank to the separate species *S. psychrophila* by Schellenberg (1931), because it differs in several respect from nominate subspecies *S. crenulata crenulata*.

The interspecific molecular distances of 17,3% ±2% between *S. crenulata* and *S. anneheleneae* sp. nov. confirm the species concept of *Syrrhoe* of the North Atlantic, which is based on minute morphological differences.

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